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Meningioma in the Pineal Region. A Report of Two Cases, Removed by Operation*.

By

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【和 文 内 容 抄 録】

松果腺部ニ「メニンジオーム」ノ發生スル事ハ極メテ稀ナリ。茲ニ報告セルソノ2例ハ米國市俄古大學醫學部神經外科教授 Dr. Percival Bailey ニヨツテ手術剔出セラレ、著者ニソノ發表ヲ許可サレタルモノナリ。何レモ中年ノ患者ニテ、腦壓亢進症狀ヲ主トシ、松果腺部局所ニ特有ナル神經學の症狀少ク、1例ハ腦室盈氣撮影法ニヨリ、他ハ「線寫眞」ニ現ハレタル松果腺部ノ石灰化腫瘍像ニヨツテ診斷セラレタルモノナリ。斯ル部位ニ於ケル「メニンジオーム」ノ發生機轉ニ就テハ松果腺周圍ノ velum interpositum ヨリ發生セリト考フルガ最モ至當ナレドモ、松果腺自個ヨリ發生スベキ可能性モ除外スルコト能ハズ。(自抄)

Meningioma in the pineal region is of extremely rare occurrence. After a thorough search I was able to find only one case in the literature, reported by Zeitlin¹⁾. Although in the early literature some cases are reported as psammomas by Friedlich²⁾ and Blanquinque²⁾, or as psammo-sarcoma by König²⁾, it is not sure, whether they are really meningiomas or not, because some other kinds of pineal tumor can contain calcified bodies, and even senile pineal bodies may show extensive calcification.

will be added to the literature.

Case 1. B. W., an American woman of fifty-seven years, was admitted to the University of Chicago Clinics, Unit No. 105689, on June 11, 1934, complaining of headache, failing memory and staggering gait.

She had never had any severe illness, and no operations except for removal of a goitre eleven years previously. She had been well except for occasional sore throats until 1932, when she began to have occasional attacks of sharp lancinating pain shooting from the occipital region into the forehead. After about a year the pain became a dull occipital headache. She complained also of noises like escaping steam in the head. Her legs also became unsteady so that for six months she was unable to walk without assistance. For the last year also her memory failed. She had passed through a normal menopause at the age of fifty.

General physical examination was normal except that the blood pressure was slightly elevated, 158/78. When admitted to the hospital she was very cooperative but given to silly witticisms. The optic discs were swollen about three diopters with numerous hemorrhages. Visual fields were normal. The pupils were equal, 3.5 mm. in diameter, and reacted sluggishly to light, promptly to accommodation. Convergence was good. The eyes were moved freely in all directions. There was no nystagmus. Audiometer and caloric tests were not made, but hearing seemed normal to usual gross tests with watch and tuning forks. The other cranial nerves were also normal. All movements of arms and legs were made with normal strength. There was no atrophy, spasticity or hypotonicity. Sensation to pinprick, cotton wool, position and vibration was normal over the trunk and limbs. There was very little tremor or asynergy of the limbs but the patient reeled when trying to walk and fell to the left and backward. The tendon reflexes were all brisk, but there was no clonus at the ankles and no Babinski sign. Wassermann and other tests on the blood and urine were normal.

In the roentgenogram of the skull the pineal body was faintly seen and seemed to be slightly anterior and below its usual position, when measured by the method of Sosman and Dyke. This fact, together with the history of tinnitus, aroused the suspicion of a pineal tumor but the calcification appeared to be such as one observes in a normal pineal body. The eyes could be moved conjugately upward normally. The patient was too old for any glandular symptoms to appear. The findings were considered too meagre to permit a localization from the clinical symptoms alone; so on June 14 a ventriculogram was made which demonstrated the fact that the posterior part of the third ventricle was occupied by a mass in which was the calcification supposed to be pineal (Fig. 1).

A diagnosis was now made of tumor in the region of the pineal body and on June 19, 1934, Dr. Percival Bailey made an exploration under combined avertin and ether anesthesia. An osteoplastic opening was made in the left parieto-occipital region, the left lateral ventricle punctured and emptied of fluid, the superior cerebral veins ligated, the left hemisphere retracted and the posterior part of the splenium corporis callosi transected. The tumor lay at the junction of falx cerebri and tentorium cerebelli and projected forward under the splenium. The

tumor was about 3.5cm. in diameter and firm, reddish gray in color. Its upper surface was dissected free from the falx cerebri, and the interior removed with an electric loop. Part of the tumor was necrotic and was removed with a suction apparatus. The central portion of the tumor was removed but the lateral capsules, to which were attached the internal cerebral veins, were left. The bleeding was carefully checked and the wound closed, on small rubber drain being left in the cavity. The blood pressure at the close of the operation was 110/80.

The wound healed promptly, but the patient was very disoriented, incontinent and lethargic. On June 25, 1934 she could not move her eyes upward and the left pupil did not react to light. On July 4 upward conjugate movement of the eyes was weak but possible. The left pupil reacted sluggishly to light. She was discharged on July 7, 1934, mentally clearer but jocular, still confused, and untidy. The optic discs had subsided.

The patient returned for examination on July 31, 1934. She was much better but could not walk unaided. She was still jocular and had a poor memory for recent events. She was occasionally incontinent of urine at night. The optic discs were obscured and possibly slightly elevated. There was edema of the ankles, but the heart seemed normal, the blood pressure 160/90. An electrocardiogram was essentially normal. She returned again on October 5, 1934 definitely worse, disoriented and incontinent. She did not complain of headache but the optic discs slightly swollen.

The patient remained confused, with poor memory for recent events, but very talkative. She was able to walk with assistance and seemed to have no paralysis. She never complained of headache. Despite a good appetite she wasted away, became gradually bedridden, developed bed sores, and died on September 17, 1935 with a terminal bronchopneumonia. There was no necropsy.

Microscopic description of the tumor: The tumor is composed of elongated cells which have a tendency to an arrangement in whorls (Fig. 2). Numerous whorls about capillaries. There are no mitoses and very little reticulin except in the walls of blood vessels. No psammoma bodies are present. The tissue is extensively degenerated but the healthy portions have the structure of a meningioma.

Case 2. J. M., a man of forty-four years, was admitted to the University of Chicago Clinics, Unit No. 167820, on January 25, 1937, complaining of headache and dizziness, referred by Dr. A. P. Martin of Chicago.

He was born in Greece, worked as a waiter in a restaurant and had never been seriously ill. In 1921 he had a palsy of the left seventh nerve. His present illness began about January 1936 when he began to have occasional pains in the suboccipital region. They occurred whenever he suddenly moved his head either forward or to either side. In August 1936 he began to have a stiffness in the legs, and an unsteadiness such that he had to quit work. During September he lay around and did no work. In October for a period of two weeks he was very ill with headache and rare vomiting, stupor and incontinence. Later he became better but remained drowsy, his vision failed and he was very unsteady when walking.

When admitted he was lethargic but cooperative. There was no suboccipital stiffness or tenderness. The skull was very brachycephalic but not otherwise remarkable. The pupils were equal, normal in size, and reacted sluggishly to light but promptly to accommodation. External ocular movements were normal, including conjugate upward deviation. The optic discs were swollen five diopters. The visual acuity was reduced so that he could not read the finer type of an ordinary newspaper with either eye. The visual fields were normal. A normal caloric response was evoked from either labyrinth. Auditory acuity was slightly reduced in each ear for tones in the higher frequency. There was a contracture of the left facial muscles (secondary to old Bell's palsy). The other cranial nerves were normal. Sensation over body, limbs and face was normal. The strength of all muscle groups of limbs and trunk seemed normal. There was no incoordination of the movements of the extremities but Romberg's sign was positive and in walking the patient was very apt to fall suddenly backward. The tendon reflexes were everywhere brisk. The plantar reflexes were flexor. Blood Wassermann was negative.

An X-ray of the head disclosed in the region of the pineal body an extensive nodular calcification (Fig. 3). Because the patient was born and lived in Greece until the age of sixteen the possibility of a hydatid cyst was considered. Complement fixation test for echinococcus was very strongly positive. But the calcification was not characteristic of cysticercus nor was there any evidence of such involvement elsewhere in the body.

A diagnosis was therefore made of tumor of the pineal body and on January 30, 1937 an operation was performed by Dr. Percival Bailey. Under combined avertin and ether anesthesia a bone flap was turned down in the left (because the calcification lay mainly to the left of the midline) occipital region. There was an unusual number of superior cerebral veins in the occipital region which were ligated and divided. A T-needle was placed in the dilated lateral ventricle and the occipital lobe could then be retracted widely giving adequate access to the pineal region. The thin splenium of the corpus callosum was then divided and the nodular surface of a reddish-gray firm tumor was exposed. The tumor was about 4 cm. in diameter. It was carefully dissected away from the inferior margin of the falx cerebri back of the splenium. The internal cerebral veins could be seen running around the lateral margins of the growth. In dissecting away the right vein it was injured and had to be ligated. The left internal cerebral vein was dissected away, the anterior surface of the tumor freed and the main mass removed. In doing so the third ventricle was opened. The posterior portion of the tumor in the region of the vein of Galen was left. It could not be dissected free and was too tough to be removed by sucker or curette. Moreover the electric loop could not be used because it was too calcified. The wound was therefore closed with one small rubber drain leading down into the third ventricle. At the end of the operation the patient's blood pressure was 120/60.

His temperature that evening rose to 39°C and his pulse to 170. The blood pressure

dropped alarmingly, so a transfusion of blood was given. He then recovered slowly so that by February 5 his temperature was 37.2°C and the pulse 110 with a blood pressure of 138/90. The drain was removed on the second postoperative day. It was evident on the day following operation that the patient had a right homonymous hemianopia, a right hemiplegia and an anomia. These symptoms began to improve on February 4 and by February 9 the hemiplegia and anomia had practically disappeared. But the hemianopia persisted. Although he had no headache and felt well, the bone-flap was riding up and the swelling of the optic discs had not subsided, so on February 9 a T-needle was placed in the occipital horn of the right lateral ventricle and allowed to drain permanently. There was a transitory rise of temperature to 39°C which descended the following day. The bone flap subsided and healed in place. He was very well until February 18 when his temperature suddenly rose to 40°C and remained high. His pulse, however, ranged only from 100 to 120, blood pressure was normal and there were only 5,400 leucocytes in the blood. We had about made up our minds to reopen the wound and attempt to remove the remaining nodule of tumor when the temperature began to subside and on February 20 was normal and remained so. The T-needle was removed from the right ventricle, the wound healed promptly and the patient remained well.

He was discharged from the hospital on March 6, 1937, feeling very well. His vision was 0.6 in the right eye and 0.3 in the left. There was still some swelling of the optic discs (0.5 diopters in the left and 1.5 diopters in the right) but the veins were of normal caliber. There was a right complete homonymous hemianopia. He could walk unaided but somewhat unsteadily. There was no trace of any hemiplegia and his speech was normal.

The patient returned for examination on April 12. He was more unsteady on his feet than before. No headache. No discomfort of any kind. Fundi only slightly elevated. Temporal margin of discs clear. Cups visible. Right hemianopia. Indifferent and memory for recent events bad. He was last seen on April 30, 1937. The fundi were unchanged. No headache. No discomfort of any kind. He had had an attack of influenza and now walked less well. He was very disoriented to the point of being unable to find his way about his own home. He was in very good humor and indifferent to his condition. It was very easy to care for him but he was untidy. During the night he was incontinent of urine but never in the day time. His memory was excellent for past events, but poor for recent events.

Microscopic examination of the tumor. The tumor is found to be composed of spindle-shaped cells with round or elongated vesicular nuclei, containing a small amount of chromatin (Fig. 4). No mitotic figures are seen. The cells are arranged in long bundles or in whorls. Reticulin is not found among the tumor cells except in the walls of blood vessels. The calcification proved to be mainly in amorphous form in the connective tissue but a few typical psammoma bodies were found.

Comment.

Several points in regard to the diagnosis of these cases may be mentioned. (1) In the neurological features of the two cases, signs of increased intracranial pressure were predominant, localizing symptoms being rather meagre, except for the history of tinnitus in the first case and for suggested double Argyll-Robertson pupil in both, which was regarded by Wilson³⁾ as one of the most important signs of lesions in the pineal region. In either case disturbed conjugate upward movement of the eyes, which is pathognomonic for pineal tumor, was not demonstrated. The definite diagnosis was made in the first case by a ventriculogram and in the second by the presence of a calcified tumor shadow in the pineal region in X-ray films. (2) Of pineal tumor, teratomas are generally believed to give most frequently calcified shadows in X-ray films, so that their presence was regarded by Horrax and Bailey⁴⁾ as one of the signs by which pineal teratomas could be differentiated from pinealomas. The latter may sometimes contain calcified bodies microscopically, but usually not to such an extent as to be recognized in roentgenograms. The calcification of teratomas may show roentgenologically characteristic features, consisting of several smaller, sharply defined, dense shadows (Fassbender⁵⁾). That is entirely different from the calcification in our second case. Moreover, it is to be noticed that both of our patients are of middle age, fifty-seven in the first case and forty-four in the second. According to my knowledge no teratoma has been reported in the literature, occurring in patients over thirty years of age (Haldeman⁶⁾). From these facts the probability of pineal teratoma could not be taken into consideration. The roentgenologically visible calcification within meningiomas in general does not usually show any characteristic feature, by which they can be differentiated from other tumors. But according to Sosman and Putnam⁷⁾ calcification in meningiomas may be as a rule, well defined and outlines the tumor sharply. Also Camp⁸⁾ states that calcification within meningiomas may be of two types, (a) punctate and discrete areas of density corresponding to the psammoma bodies which these tumors frequently contain, and (b) a conglomerate mass of calcareous material. Following these descriptions the calcification in our second case seems to correspond more to meningioma than to any other tumor. Therefore, if the pineal meningioma were of more frequent occurrence it

3) Wilson, S. A. K. and Rudolf, G. de M.: Case of mesencephalic tumor with double Argyll-Robertson pupil. *J. Neurol. and Psychopath.* 3: 140, 1922.

4) Horrax, G. and Bailey, P. Tumors of the pineal body. *Arch. Neurol. and Psychiat.* 13: 423—470, 1925.

5) Fassbender, Fritz. Über einen Fall von Praecositas somo-psychogenitalis bei einem 7 1/2 Jahre alten Mädchen. *Ztschr. f. Kinderh.* 54: 642—655, 1933.

6) Haldeman, K. O. Tumors of the pineal gland. *Arch. Neurol. & Psychiat.* 18: 724—754, 1927.

7) Sosman, M. C. and Putnam, T. J.: Roentgenological aspects of brain tumors—meningiomas. *Am. J. Roentgenol. and Radium Therapy.* 23: 615—624, 1930.

8) Camp, J. D. Intracranial calcification and its roentgenologic significance. *Am. J. Roentgenol. and Radium Therapy*, 23: 615—624, 1930.

might for this reason have been suspected before operation. Elkington⁹⁾ reported a case of calcified pineal tumor in a forty-seven year old woman, which was unfortunately not verified, so that the nature of the tumor was not established but it might possibly have been a meningioma.

(3) As the histories show, we cannot find any particular symptoms or signs in our cases, which may serve to distinguish meningioma from other tumors in the pineal region. The general diagnostic principle that meningiomas, especially of the psammomatous type of Bailey and Bucy¹⁰⁾ have a long history (Craig¹¹⁾), does not seem to be valid in case of meningiomas in the pineal region. Horrax¹²⁾ showed that the onset in all of his cases of pineal tumor began with pressure symptoms. Pineal tumor of any nature makes its presence clinically recognizable at first by mechanical pressure on the aqueduct of Sylvius, thus causing increased intracranial pressure, whenever the size of the tumor reaches such a point as to obstruct the aqueduct—usually described as walnut size—although until that point is reached this particular area of the brain will tolerate growths without showing any symptoms²⁾. The disturbance of the flow of cerebrospinal fluid in the ventricular system is therefore the determining factor, which makes the patients consult physicians. Thus we cannot know the presence of pineal tumor until pressure symptoms appear, unless the tumor accompanies the syndrome of pubertas praecox, which is observed only in a small percentage of cases and not to be expected at the adult age, where meningiomas usually occur. If the obstruction of the aqueduct has once taken place, the course thereafter is almost the same, no matter whether the tumor is slowly growing or not. It seems to be for this reason that the autopsy we find a remarkable uniformity in the size of different pineal tumors whatever their nature may be⁵⁾, although, generally speaking, teratomas are probably more benign than pinealomas, and that in the cases of pinealomas reported by Horrax and Bailey⁴⁾ the duration of time from the onset of pressure symptoms to death did not definitely differ between the group of pinealomas, which are considered grossly and microscopically to be benign, and those of more malignant type. Thus it is evident that meningiomas in the pineal region do not have particular signs and symptoms, which may serve for the differential diagnosis from other types of pineal tumor. The most one could say would be that a meningioma might be suspected when an extensive calcification occurs in the pineal region of an adult.

(4) It is to be noticed that our second patient, who had come from Greece, showed positive complement fixation test for echinococcus. Because echinococcus can infest the brain, even though relatively infrequent, such patients from eastern Europe should always be suspected of hydatid disease, especially when serological tests for echinococcus are positive. In our case, however, so far as the calcified tumor in the pineal region is concerned, hydatid disease of the

9) Elkington, J. St. C. Calcified pineal tumor. *Proc. Royal Soc. Med.* 25: 1533—1534, 1932.

10) Bailey, P. and Bucy, P. C. The origin and nature of meningeal tumors. *Am. J. Cancer* 15: 15—54, 1931.

11) Craig, W. McK. Malignant intracranial endotheliomata. *Surg. Gynec. and Obst.* 45: 760—768, 1927.

brain was not probable for the following reasons: According to Dew¹²⁾, (a) in case of primary single cyst of the brain; i) It occurs far more frequently (about seven times) in children (4.3%) than in adults (0.5%). ii) No calcified case of cerebral hydatid cyst has been reported. iii) The seat of predilection is the subcortical substance of a cerebral hemisphere, especially of the parietal region. b) In case of secondary multiple cysts of the brain which occur more frequently in adults than in children; i) They are always secondary to a cyst of the left side of the heart. Therefore we are usually able to find a definite cardiac disorder clinically, which was not the case with our patient. ii) When a simple cardiac cyst is ruptured, the patient falls into a sudden collapse. There is no history of such an event in our case. iii) Secondary multiple cysts of the brain usually show diverse and protean signs.

Since the complement fixation test for echinococcus is believed by modern investigators to be specific for hydatid disease (Kolmer¹⁴⁾, Fairley¹⁵⁾, Dew¹³⁾ and Thomsen and Magnussen¹⁶⁾, although adequate controls should be run for Wassermann reaction (Todd-Sanford¹⁷⁾, Kolmer¹⁴⁾ (negative in our case), this patient may have hydatid disease somewhere else in the body. But from the facts mentioned above we have no reason to suppose that his present intracranial trouble might be due to a cerebral echinococcus cyst.

(5) In such patients as ours another possibility of an intracranial parasite, namely *cysticercus cellulosae*, should be taken into consideration. As a parasite of the brain *cysticercus* is in Europe, especially in its eastern parts, much more common than echinococcus. In cysticercosis the brain is infested with particular predilection. Of the 807 cases collected by Vosgien¹⁸⁾ 330 (41%) showed involvement of different parts of the brain. In Stephens' series¹⁸⁾ of cases there were 105 brain cases, 30 muscle cases and only two skin cases. In the differential diagnosis of our present case, cysticercosis in the ventricular system is of particular importance, since the fourth ventricle is usually the site of the disease. But in some cases the third ventricle instead of the fourth may be involved, because *cysticercus* enters the ventricular system through the choroid plexus and is then brought to the fourth ventricle by the flow of the cerebrospinal fluid, thus making it possible that any part of the ventricular system be infested. Allen and Lovell¹⁹⁾ reported two cases of *cysticercus* cyst of about cherry

12) Horrax, G. Differential diagnosis of tumors primarily pineal and primarily pontile. Arch. Neurol. and Psychiat. 17: 179—192, 1927.

13) Dew, H. R. Hydatid disease. Its Pathology, Diagnosis and Treatment. Australasian Med. Publ. Co. Sydney, 1928.

14) Kolmer, J. A. Serum diagnosis by complement fixation with special reference to syphilis. Lea and Fibiger. Phila. 1928, p. 544.

15) Fairley, N. H. Researches on the complement fixation reaction in hydatid disease. Quart. J. Med. 15: 244—267, 1922.

16) Thomsen, O. and Magnussen, G. Ueber spezifische Antikörper bei Echinokokkenkranken. Berl. klin. Wchnschr. 49: 1183—1184, 1912.

17) Todd-Sanford. Clinical diagnosis by laboratory methods. Saunders, 1935, p. 500.

18) Quoted from Chung, H. L. and Lee, C. L. Cysticercosis in man with special reference to involvement of central nervous system. Chinese M. J. 49: 429—445, 1935.

19) Allen, S. S. and Lovell, H. W. Tumors of the third ventricle. Arch. Neurol. and Psychiat. 28: 990—1006, 1932.

size arising from the roof of the third ventricle and blocking the posterior part of it, so as to cause a tremendous hydrocephalus. Because of the nearness of such a cyst to the pineal body, it is easily understood that it may simulate the syndrome of pineal tumor. In addition cerebral cysticercosis occurs rather more frequently in adults than in children. According to Henneberg²⁰⁾ the average age of patients at the time of death is thirty-five in cases of cysticercus in the fourth ventricle.

In our case, however, cysticercosis of the brain can, so far as the present troubles are concerned, be easily differentiated for the following reasons: i) Dixon and Smithers²¹⁾ and Morrison²²⁾ state that the calcification of the cysticercus cysts in the brain is less often seen and tends to occur at a later stage than elsewhere. In Allen and Lovell's cases, although no word about calcification can be found, calcification seems to have been absent, judging from the thin wall of the cyst. The reasons for the rarer occurrence of calcification in cerebral cysticercosis may lie in the first place in good blood supply in surrounding structures and in the second in that calcification takes place after the death of the parasite, i.e. after four or five years of infestation, too long a period to live for the patients with cerebral, at least intraventricular, cysticercosis, which may be expected to give rise early to grave symptoms, as can be surmised from the fact that the average survival period of the patients with cysticercosis in the fourth ventricle is only nine months from the onset of the symptoms (Henneberg²⁰⁾). ii) However, calcification of cerebral cysticercus, even though it is less frequent and almost always in the meninges, does occur, as reported by Morrison²²⁾, O'Sullivan²³⁾, Sorge²⁴⁾ and Camp⁸⁾. In these cases calcification (usually only of the scolex) appeared in X-ray films as small round shadows (Morrison), several dense, pea-sized, sharply defined shadows with somewhat irregular contour (O'Sullivan), small elongated bipolarly or pointed and sharply defined shadow (Sorge) and according to Camp might be annular shadows representing the walls of the cyst. All these descriptions do not correspond to the calcified shadow in our case, which is much larger and nodular. iii) Calcification in our case was situated almost exactly in the pineal position, which may not be expected even in case of cysticercosis of the third ventricle. For these reasons it was not probable that the calcified tumor might be a calcified cysticercus cyst.

(6) Thus from the point of differential diagnosis, the following probabilities might have been considered before operation.

20) Henneberg, R. *Der Cysticercus cellulosae*, in Kraus und Brugsch's spezielle Pathologie und Therapie innerer Krankheiten. Bd. X, 2 Teil 165, 1924.

21) Dixon, H. B. F. and Smithers, D. W. *Epilepsy in cysticercosis (taenia solium)*. A study of seventy-one cases. *Quart. J. Med.* 27: 603—616, 1924.

22) Morrison, W. K. *Cysticercosis in twin brothers aged thirteen years, with a radiological study of the calcified cysticercus in twelve cases*. *Brit. Med. J.* 1934 I, 13—14.

23) O'Sullivan, J. *Some rarer intracranial calcifications and ossifications*. *Brit. J. Radiol.* 30: 295—304, 1925.

24) Sorge, F. *Cysticercose im Verkalkungszustand*. *Arch. f. Klin. Chir.* 185: 31—37, 1936.

In the first case: Some tumor other than teratoma, which can be excluded because of the advanced age. Possibility of parasitic tumors does not come into consideration in this case, because she is born in the United States where such parasites are practically unknown in the native born.

In the second case: Teratoma can be excluded for the same reason as in Case 1. Echinococcus or cysticercus of the brain is not probable as mentioned above. From the extensive calcification, pinealoma seems to be improbable. Therefore, some other tumor should be considered. Diagnosis of meningioma in the pineal region was not made, because of its extremely rare occurrence, although the character of calcification and the age of the patient were rather in favor of meningioma.

General comment.

It is generally accepted today that meningioma takes its origin from arachnoid cells. But when Schmidt²⁵⁾ and Cushing²⁶⁾ published their views upon this point, they did not believe that this tumor might occur in any portion of the arachnoid, but that it arose from arachnoid tufts and pacchionian granulations which normally invaded the dura. That is true in most cases (Aoyagi-Kyuno²⁷⁾). But meningioma can occur without any connection with the dura in regions where there are no such tufts of arachnoid. Hosoi²⁸⁾, Roser²⁹⁾, Christoph, Divry and Moreau³⁰⁾ and Busscher³¹⁾ reported meningiomas arising from the choroid plexus of the lateral ventricle, which is nothing but a normal extension of the pia-arachnoid covered with neuroepithelium. Furthermore, Alpers, Yaskin and Grant³²⁾, and Petit-Dutailis and Bertrand³³⁾ described typical meningiomas, which developed entirely within the brain substance, taking their

25) Schmidt, M. Ueber die Pacchionischen Granulationen und ihre Verhältnisse zu den Sarkomen und Psammomen der Dura mater. *Virchows Arch. f. Path. Anat.*, 170: 429, 1903.

26) Cushing, H. The meningiomas (dural endotheliomas). Their source and favored seats of origin. *Brain*, 45: 282—316, 1922.

27) Aoyagi, T. and Kyuno, K. Ueber die endothelien Zellzapfen in der Dura mater cerebri und ihre Lokalisation in derselben, nebst ihrer Beziehungen zur Geschwulstbildung in der Dura mater. *Neurologia*. 1912, XI, 1—12.

28) Hosoi, K. Meningiomas, with special reference to the multiple intracranial type. *Am. J. Path.* 6: 245, 1930.

29) Roser, F. Über Meningeome und einen zur Gruppe des Meningeoms gehörigen Fall eines intracerebralen Tumors. *Acta path. Scand.* 10: 288—303, 1933.

30) Christoph, Divry and Moreau. Un cas de psammome des plexus choroïdes du ventricule latéral. *J. Belge de Neurol. et de Psychiat.* 34: 733—738, 1934.

31) Busscher, J. Ueber das intraventriculäre Meningeom des rechten Hinterhorns. *Z. f. d. ges. Neurol. u. Psychiat.* 152: 522—529, 1935.

32) Alpers, B. J., Yaskin, J. C. and Grant, F. C. Primary fibroblastoma of the brain. *Arch. Neurol. and Psychiat.* 27: 270—281, 1932.

33) Petit-Dutailis, D. and Bertrand, I. Fibroblastome profond, intracérébral de l'hémisphère gauche, sans connexions méningées décelables. *Rev. Neurol.* II. 96—100, 1932.

origin presumably from perivascular pia-arachnoid cells (Schaltenbrand and Bailey³⁴). Keeping these facts in mind, we may now discuss the probable source of a meningioma in the pineal region. Here we can consider two possibilities, an origin from the pineal body itself or from the velum interpositum.

1) The fundamental connective tissue of the normal pineal body arises from the pia-arachnoid and enters the parenchyma of the pineal body with the vessels around which it constitutes adventitiae limiting the lymphatic spaces of Virchow-Robin (Rio-Hortega³⁵). If, therefore, meningiomas could arise from the perivascular pia-arachnoid within the brain substance, it is not impossible for meningiomas to occur within the pineal body.

In addition to that "in the course of development of the pineal body, the two anlagen, anterior and posterior, described by Krabbe, are at first separated by a cleft filled with connective tissue, but during fetal life they fuse with each other. A connective tissue septum in the area of separation of the two anlagen remains until the end of development³⁵." Here we can find another possible source of a meningioma within the pineal body.

From these considerations it would seem that the development of meningiomas within the pineal body is possible, even though not probable in most cases.

2) The derivation of meningiomas from the velum interpositum is much more easily conceivable, the tela choroidea of the third ventricle being covered by a continuation of the pia arachnoid. Thus Zeitlin assumed that the meningioma of his case, which was verified by autopsy, arose from the pia mater about the pineal body. This assumption may be more probable than that of an origin within the pineal body itself, although one has some difficulty in believing that in Zeitlin's case a well encapsulated, slowly growing meningioma did involve and destroy a neighboring structure (pineal body) completely, without leaving any vestige of it. It would be necessary to cut the entire region into serial sections before being sure that no pineal tissue was left. In our two cases it is not sure whether somewhere about the tumor some trace of the normal pineal body is left or not, because they were both removed by operation from such a deep and restricted area of the brain, that sufficiently thorough search was impossible. Therefore, one cannot offer any conclusive evidence as to the primary seat of these tumors. The problem may possibly be the same as in teratomas of the pineal region, which occur not infrequently outside of the epiphysis, as reported by Heilmann and Rückart³⁶, McLean³⁷ and others, although teratomas may actually arise from within the pineal substance. Thus one may conclude that the primary seat of meningiomas in the pineal region is probably the velum interpositum, but the possibility of an origin from the pineal gland itself cannot be excluded.

34) Schaltenbrand, G. and Bailey, P. Die perivaskuläre Pia gliamembran des Gehirns. J. f. Psychol. u. Neurol. 35: 199, 1927—1928.

35) Rio-Hortega, P. Del: Pineal Gland, in Cytology and Cellular Pathology of the Nervous System. Hoeber. 1932, 635—703.

36) Heilmann, P. und Rückart, F. Beitrag zur Frage der körperlichen und geistigen Frühreife bei Geschwülsten in der Schädelhöhle. Beitr. z. path. Anat. 89: 237—241, 1932.

37) McLean, A. J. Pineal teratomas. Surg. Gynec. and Obst. 61: 523—533, 1935.

Summary.

Two cases of meningioma arising in the pineal region are reported. The first case is a female of fifty-seven years and the second a man of forty-four. They had the history of increased intracranial pressure of some months' duration and of some cerebellar symptoms since six months before admission. In the first case tinnitus was also complained of. Neurological examination showed nothing more than signs of general pressure, some cerebellar signs and suggestive double Argyll-Robertson pupil. No disturbance of conjugate upward movement of the eyes. In the roentgenograms of the skull calcified shadows in the pineal region were seen in both cases. In the second case the calcification was unusually extensive, deep and nodular, so that the diagnosis of calcified pineal tumor was definite, whereas in the first case the faint pineal shadow remained within normal limits except that it seemed to be slightly anterior and below its usual position, and for the definite diagnosis a ventriculogram was taken, which clearly showed a mass occupying the posterior part of the third ventricle.

In both cases operation was done by transcallosal approach and a firm tumor, which was about 3 to 4 cm. in diameter and reddish-gray in color, was removed almost totally in each. Both tumors proved microscopically to be meningiomas with typical whorl formation. The postoperative course was in the first case not so excellent as was hoped. After some relief for several months, the patient gradually became worse and died fifteen months after operation. In the second case, although the patient had some difficulty shortly after operation, he recovered fairly well and was discharged on the 35th postoperative day, still having some degree of choked disc, but subjectively feeling very well.

In the further course he is recovering slowly, even though still unable to work.

As to the primary seat of the tumor, the velum interpositum is most probable, but the possibility of an origin from the pineal body itself cannot be excluded.



Fig. 1. Case 1. Ventriculogram showing defect in the posterior part of the third ventricle.

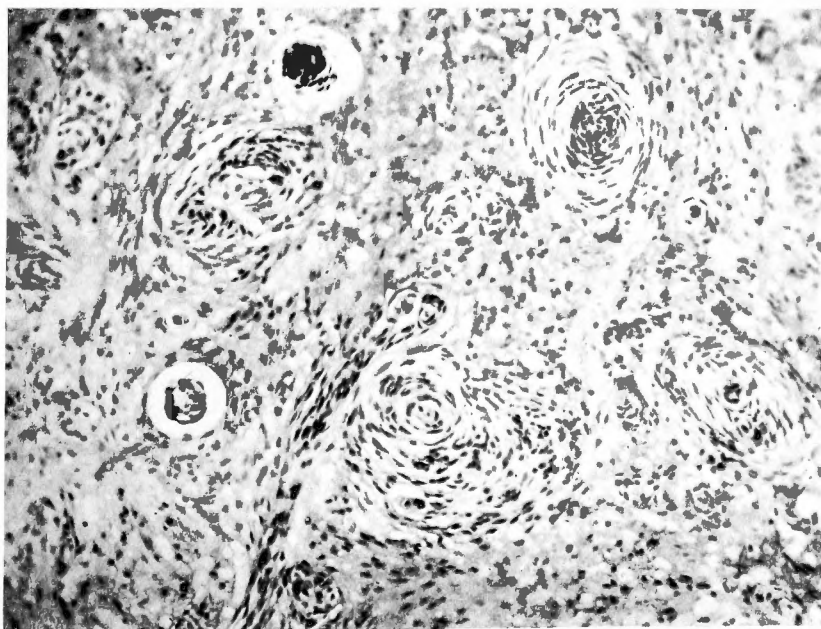


Fig. 2. Case 1. Photomicrograph of tumor. Hematoxylin-eosin $\times 150$.
The tumor is quite degenerated but typical whorls of cells are clearly seen.

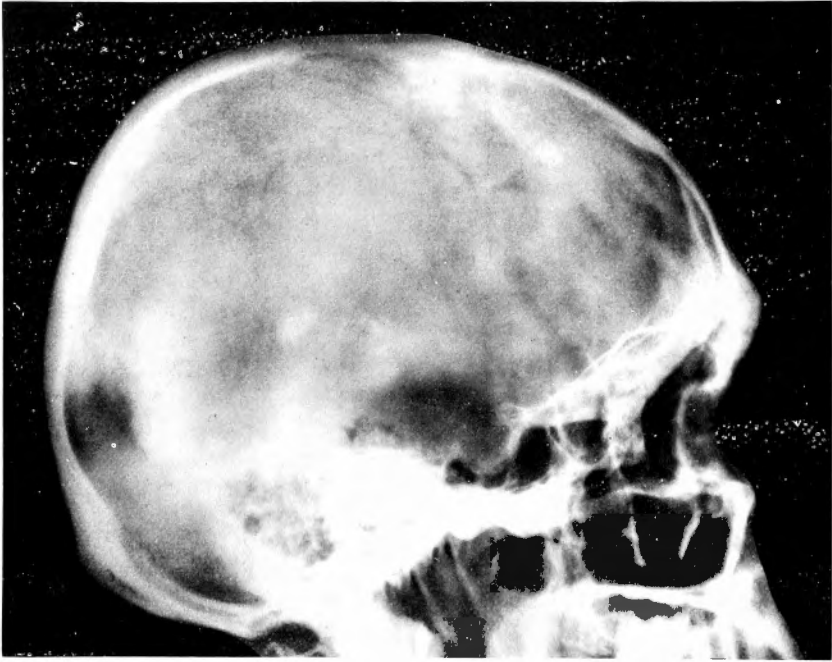


Fig. 3. Case 2. Roentgenogram of the head showing calcification in the pineal region.

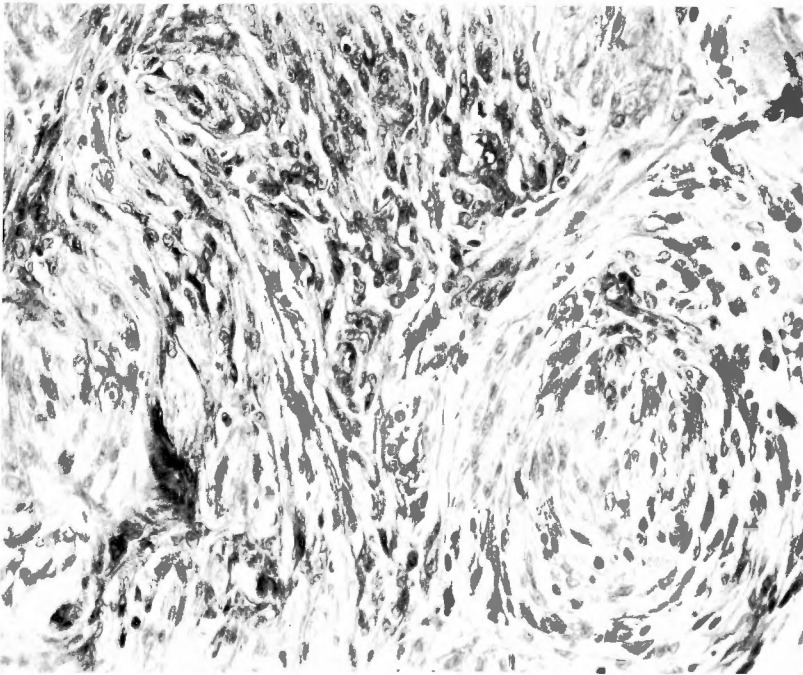


Fig. 4. Case 2. Photomicrograph of tumor. Hematoxylin-eosin $\times 300$. Showing typical whorls of mesothelial cells.